PATHWAYS FOR CARBON REDUCTION AND ABIOTIC ORGANIC SYNTHESIS IN AQUEOUS ENVIRONMENTS. T. M. McCollom[1], [1]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309 (mccollom@lasp.colorado.edu).

Introduction: Hydrothermal environments have been widespread in the solar system throughout its history, effecting the organic composition of objects ranging from meteoritic parent bodies to icy satellites to rocky planets. Hydrothermal systems are viewed by many researchers as a primary source of abiotic organic compounds on the early Earth, and may have been a critical environment for the origin of life. Over the last several decades, studies of terrestrial hydrothermal systems, including both laboratory experiments and investigations of natural systems, have provided new insights into the potential for synthesis of organic compounds from inorganic carbon in aqueous environments. This presentation will summarize several recent results bearing on abiotic organic synthesis in solar system bodies.

Constraints on organic synthesis: Several recent studies have confirmed previous findings that reduction of dissolved inorganic carbon to organic compounds is extremely sluggish at temperatures below about 350 °C, inhibiting abiotic formation of methane and other compounds. Consequently, it appears that hydrocarbons present in deep-sea hydrothermal systems derive from reactions occurring at high temperatures deep within oceanic crust. Abiotic synthesis appears to be much more favorable in environments where gas-phase inorganic compounds are present, and CO is much more reactive than CO_2. These considerations suggest that shallow or subaerial hydrothermal environments may be more favorable for abiotic orgnaic synthesis than deeper systems. Conversion of inorganic carbon to organic compounds requires catalysis, and particularly favorable catalysts include native transition metals, metal carbides, and sulfide minerals. Some simple compounds such as formalehyde, HCN, and formamide are highly reactive and have been found in laboratory experiments to produce complex organic compounds that include saccharides, amino acids, and nitrogenous bases. However, experiments that produce these kinds of products are usually performed at concentrations of the compounds that are many orders of magnitude higher than would be present in any aqueous environment in the solar system, so their implications for natural environments are uncertain.